THE TREATMENT OF LATERAL CURVATURE OF THE SPINE

BERNARD ROTH.

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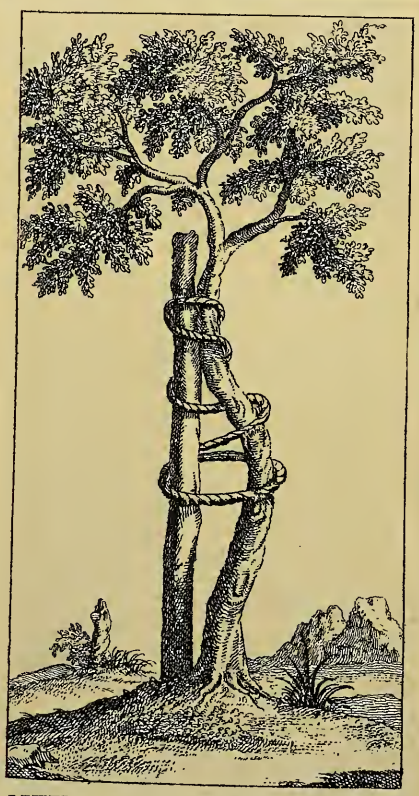

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THE TREATMENT

OF

LATERAL CURVATURE

OF

THE SPINE,

WITH

APPENDIX

ON

THE TREATMENT OF FLAT-FOOT.

BY

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PREFACE.

Although my views on the prognosis and treatment of Lateral Curvature of the Spine have undergone considerable modification during the fourteen years I have been engaged in orthopædic practice, this monograph is mainly based on the article "Lateral Curvature of the Spine" which I contributed to Mr. C. Heath's "Dictionary of Practical Surgery," 1886; on the papers published in the *British Medical Journal*, "The Treatment of Lateral Curvature of the Spine," *May* 13*th*, 1882; "Two Hundred Consecutive Cases of Lateral Curvature of the Spine treated without Mechanical Supports," *October* 31*st*, 1885; and "Scoliosiometry, or, An Accurate and Practical Method of Recording Cases of Lateral Curvature of the Spine," *October* 27*th*, 1888; and on the paper read before the Clinical Society (*April* 13*th*, 1883), "A Case of Lateral Curvature of the Spine, illustrating its Treatment without the Use of Mechanical Supports" (vol. xvi. Clin. Soc. Trans., 1883).

Bernard Roth.

29, Queen Anne Street,
Cavendish Square, London, W.

February, 1889.

NOTE.—ALL SIX *photographs of Case I. were taken the same morning* BEFORE *commencing treatment. Photographs* 1, 2, *and* 3 *represent the "habitual" posture of the patient; and photographs* 4, 5, *and* 6 *represent the "best possible" posture of the same patient after she had been so placed by the Author. This improved posture could only be maintained for the second or two required for taking the photographs.*

Case I. (see page 33), all six Photographs taken the same day previous to the commencement of Treatment.

1.

2.

3.

"HABITUAL" POSTURES.

4.

5.

6.

"BEST POSSIBLE" POSTURES.

(*The Patient placed by the Surgeon.*)

7.

A GIRL, AGED 7 YEARS, WITH SEVERE OSSEOUS LATERAL CURVATURE OF THE SPINE, IN THE "HABITUAL" POSTURE.

8.

THE SAME PATIENT AS PHOTOGRAPH (7), WHEN PLACED IN THE "KEY-NOTE" POSTURE (*see page* 12).

TREATMENT

OF

LATERAL CURVATURE OF THE SPINE.

Lateral curvature of the spine is a deformity due to lateral deviation and distortion of the spinal column, nearly always accompanied by more or less exaggeration or diminution of the normal antero-posterior curves.

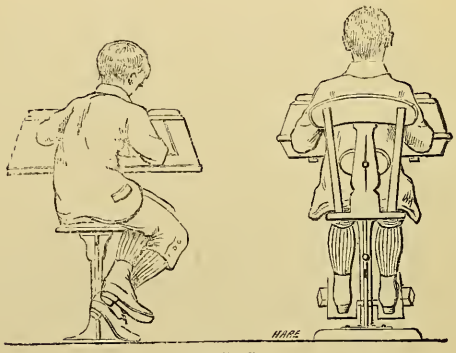
This deformity is predisposed to by weakness of the spinal muscles combined with long-continued sitting or standing in stooping or relaxed positions, such as standing on one leg, sitting writing and reading with the trunk leaning to one side (see figs. 1 and 3) or with the thighs crossed.

The position of writing, as generally practised, is, more frequently than anything else, an initial cause of lateral and other curvatures not due to diseased bone. The much larger proportion of girls than of boys affected is due to the fact that girls do not enjoy, as a rule, one-fourth of the usual amount of physical exercise, as cricket, football, etc., allowed to boys. Their muscles either never develop as they ought, or become weak; and, although they sit no worse than boys at their lessons, they have not sufficient strength to hold

themselves erect and to restore the balance of their curved backs out of school-hours. At the onset of puberty, the development of girls generally throws a greater strain on their health and strength than is the case with boys.

Inequality in the lengths of the lower extremities from various causes predisposes to lateral curvature equally in both sexes. Such causes of inequality

Fig. 1. Fig. 2.



WRITING.

Faulty Position at an ordinary desk. Proper Position at Glendenning's Patent Adjustable Desk.

in the legs may be either congenital difference in size, atrophy from infantile paralysis, hip-joint disease, or congenital hip dislocation.

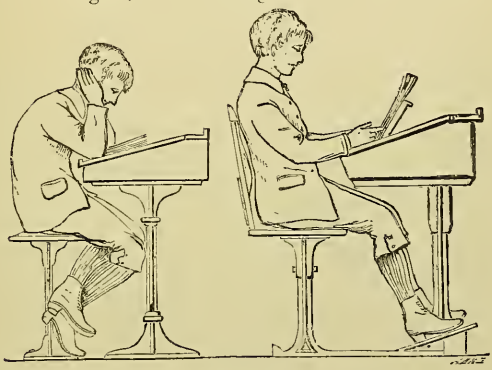
I have frequently observed a hereditary predisposition to lateral curvature, due to an inherited weakness of the muscles and ligaments, probably associated with an excessive softness of the bones.

Rickets is frequently a cause of lateral curvature, especially in very young children. As a general rule, anything which weakens the muscular system

tends to produce lateral curvature, which often therefore follows convalescence after whooping-cough, chicken-pox, measles, diphtheria, and scarlet fever.

No satisfactory explanation has yet been given why the large majority of cases of lateral curvature have the upper or dorsal lateral curve with the convexity to the right. It is very probable that

Fig. 3. Fig. 4.



READING.

Faulty Position at an ordinary desk.

Proper Position at Glendenning's Patent Adjustable Desk.

the greater use of the right arm and hand is a predisposing cause, although, at the same time, it must be admitted that cases with the convexity of the upper or dorsal lateral curve to the left are not at all limited to left-handed patients. Besides, most cases of early lateral curvature (*i.e.*, before osseous deformity is well marked) are either wholly convex to the left or have the lower or lumbar curve convex to the left.

Pain in the back, generally of the loins or under

one shoulder-blade, is the first symptom observed in a large number of cases; the pain is either a dull aching or bruised feeling; at times it is very sharp and acute, like ordinary neuralgia. In an equally large number of cases, no pain or ache is felt at first; and some deformity, as the undue prominence of a shoulder-blade or of a hip-bone (iliac crest), or general stooping, first directs attention to the presence of lateral curvature. It may be stated generally that the amount of pain complained of is seldom in proportion to the amount of deformity. Cases of extreme lateral curvature are sometimes seen where there is not, and never has been, any pain felt by the patient, although the health may have been affected in other ways: by indigestion, headache, shortness of breath, etc. On the other hand, life may have become almost unbearable on account of constant backache; and the symptoms almost assume those of so-called "spinal irritation" in cases where the curvature is but slight.

Most cases of lateral curvature of the spine, however, do suffer from backache at one period or another.

A mother notices that a shoulder or a hip is beginning to grow out in a child, often a girl at the onset of puberty. The family doctor is called in; the patient is stripped, and the trunk flexed. If there be no decided or marked irregularity in the bent spine, the parent is assured that the patient "will grow out of it," and that nothing special need be done, except, perhaps,

lying down daily for a short time. I have heard this story frequently when examining a case of incurable lateral spinal curvature which had developed in the course of one, two, or more years. It is, however, precisely at the time when there is no osseous deformity, that complete cure is possible. Before lateral curvature can occur with osseous deformity, it must gradually pass through many intermediate stages from the time when the patient first began to assume a temporary vicious position of the trunk.

Dr. Oscar Witzel, in Gerhardt's "Handbuch der Kinderkrankheiten," 1887, very ably shows that every pathological form—that is, osseous deformity of the spinal column—is preceded by a pathological posture, in just the same way that the normal osseous form of the spine in the adult is the result of the various postures of the individual during years of growth from infancy. I agree with those who maintain that in lateral curvature of the spine osseous deformity is always preceded by so-called "postural deformity." Some surgeons, however, deny that lateral curvature exists unless associated with osseous deformity of the vertebræ, and speak of "weak spines," which "frequently pass into and become cases of confirmed lateral curvature." However, when once osseous deformity has set in to that extent, the case is now acknowledged to be incurable by leading surgeons; cases with osseous deformity only differ from one another according to the degree of this deformation.

I therefore classify all cases of lateral curvature

into two large groups, quite irrespective of their causation, namely, (1) those without any osseous deformity of the ribs or vertebræ, shortly "postural stage;" and (2) those with osseous deformity, "osseous stage," which may be conveniently subdivided into (*a*) slight, (*b*) moderate, and (*c*) severe or extreme, according to the degree of the osseous deformity present.

Every case of lateral curvature, with the exception of those with extreme osseous deformity, causing complete fixation of the vertebræ, presents at least two erect postures: one when the patient is in his habitual position, and the other when placed in the best possible position by the surgeon. Now it appears to me absurd to take careful measurements of the degree of curvature of a patient at the first examination, whilst he is in a comfortable—that is, the habitual—posture, and then a few weeks or months later to take measurements again, while the patient may be in the best possible posture temporarily assumed, as appears to be done by some surgeons. Undoubtedly a series of instantaneous photographs, taken according to my suggestion in the habitual and then in the best possible posture (see photographs 1, 2, 3, 4, 5, 6, Case I.), are as good a record as can be obtained for cases of lateral curvature of the first class (postural, or non-osseous deformity, cases), and for subdivision *c*, or severe cases of the second class (osseous deformity cases). But for cases in subdivisions *a* and *b* of the second class, where the osseous deformity is only slight or moderate,

photography is less useful, as it gives no sufficiently accurate record of the amount of this bony deformity. Besides, the taking of a series of photographs entails far too much time to be frequently employed in active professional practice.

The following is the method I employ for recording cases of lateral curvature of the spine :—

The patient is placed in front of the surgeon, standing without shoes, with knees extended and feet together, all clothing having been removed to well below the iliac crests, so that the gluteal cleft is just visible. We will suppose that the legs are of equal lengths, or have been made so by a block placed under the shorter limb. Here I may say that surgeons who can draw ever so little will find a rough outline sketch of the patient's back and spine while in the habitual position useful before proceeding further, and that the curve of the spine is more readily recognised if marked with a soft copying-ink pencil (see figs. 10 and 13). After inspecting the patient laterally and in front, the trunk should be flexed as far as possible, the knees being kept extended, and the arms allowed to hang down loosely, so that the scapular muscles are thoroughly relaxed. Now the level of the ribs posteriorly, uncovered by the shoulder-blades, should be carefully examined for any inequality. In the most common form of lateral curvature with dorsal (upper) convexity to the right, if there be any osseous deformity present, the right ribs will be more or less unduly prominent, sometimes so slight that a good light and a well-trained

tactus eruditus are necessary to make out a difference on the two sides. I now take a tracing of the ribs posteriorly as follows. I feel for the lower angle of the left shoulder-blade, and, fixing one end of a pliable metal tape with my left hand at that point, I carefully mould the tape close to the ribs across the spine, to the lower angle of the right shoulder-blade, which is likewise to be carefully felt for. With the copying pencil, I mark the metal opposite the dorsal spine, and then carefully remove the tape, upper edge downwards, on to a sheet of quarto-size paper, and draw a tracing inside the tape, marking on the paper the point where the tape crossed the spine. The pencil line is afterwards inked, and the tracing cut out and folded down the middle (see fig. 14), opposite the point marking the spine, and we have now an accurate record of the ribs posteriorly (see fig. 13).

Similarly, a record is taken of the loins, usually midway on each side between the last ribs and the iliac crests—that is, opposite the third lumbar vertebra—marking the tape, as before, where it crosses the spine (see figs. 12 and 15).

A little more dexterity is required if the patient is stout or the erectores spinæ are bulky, as, if too much pressure is employed in moulding the tape to the contour of the loins, the muscles and soft tissues will cause the tape to spring up when the pressure is removed, and this will vitiate the record. This second outline is then transferred to the paper with the tracing of the ribs posteriorly.

In cases of extreme osseous deformity I have found it advisable to take the tracing of the ribs posteriorly at a higher level—that is, from the top of the left axilla to the corresponding place on the right, including thus a portion of each shoulder-blade, the patient having the trunk thoroughly flexed, as before. In this case I also mark on the metal tape where it touches the inner border of each shoulder-blade, as in the tracing of Case II. (see fig. 11).

Unless this modification is adopted—that is, taking the tracing from between the axillæ instead of from between the lower angles of the shoulder-blades—tracings of the ribs posteriorly in extreme cases are unsatisfactory, too little of the ribs posteriorly being given when the tracing simply extends from the lower angle of one shoulder-blade to that of the other, from more or less increased immovability and displacement of the shoulder-blades, as can be seen in fig. 11, where very little of the right ribs posteriorly would be shown if I had stopped the tracing on reaching the right shoulder-blade.

Although this method has taken rather long to describe, it enables a surgeon to obtain a correct and reliable record of a case of lateral curvature in less than a minute after a little practice.

The metal tape I employ is made of pure tin, and is 20 inches long, five-eighths of an inch wide, and about one-twenty-fifth of an inch thick (50 centimètres long, 1·5 centimètre wide, and 1 millimètre thick), and can be obtained from

Messrs. Mayer & Meltzer, of London, in a small case to go in the waistcoat pocket.

Several writers on lateral curvature of the spine have employed a metal tape, but their records are of but little use because the tracings were taken when the patient was erect, when the real amount of osseous deformity is more or less masked by the shoulder-blades as far as the ribs posteriorly are concerned, and by the contraction of the loin muscles with reference to the lumbar vertebræ.

When there is osseous deformity of the ribs anteriorly, especially in cases of pigeon-breast, a tracing can be easily taken from one axilla to the other, either on a level with the nipples or, where the mammæ are developed, just below or above them, marking on the tape the position of the nipples and the mid-sternum. In taking this anterior tracing the patient should be placed in the best possible position, with the thorax well thrown forwards; and he should endeavour to press against the tape whilst it is being moulded to his outline.

I have employed this method of recording cases of lateral curvature for several years past, and have found it more useful with each year's further experience of it. By its means I have been able to show gradually increasing osseous deformity in cases of lateral curvature due to infantile paralysis of the spinal muscles, than which there are no worse cases to treat, and also in bad cases of lateral curvature after empyema. I have also demonstrated further increase of the osseous

deformity where my advice has not been followed, and the patient has come back to me after an interval of months or years.

I am convinced that if this method of recording cases of lateral curvature were adopted generally, it would be the death-blow of the treatment of such cases by steel, poroplastic, and other supports, except in a few rare cases with more or less complete paralysis of the spinal muscles. These tracings enable surgeons to recognise how the osseous deformity of the ribs and vertebræ gradually progresses from bad to worse in spite of the most complicated and expensive spinal supports. It will be found that the only rational and really successful treatment of lateral curvature, and one which is far more rapid than any other yet offered to the profession, is that which I have the honour to advocate—that is, re-education of the muscular sense of the best possible position, and methodical exercises of the muscles to enable the patient to maintain this improved position without effort, or, to put it more shortly, "treatment by posture and exercise."

After this careful examination, and before the patient is allowed to dress, it is essential to ascertain to what extent the spine can be restored to its normal position by a voluntary effort, with the help of the surgeon.

In cases of group (1)—viz., "postural, or non-osseous stage"—where there is no bony deformity of the ribs or vertebræ, this "best possible position" will be perfectly normal, with the

shoulder-blades and hip-bones (iliac crests) symmetrical, the thorax well thrown out, the abdomen withrawn from undue prominence, and the head erect (see photographs 1, 2, 3, 4, 5, 6, although this case had some osseous deformity).

In cases of group (2), or "osseous stage," the improvement effected will depend on the amount of bony deformity present. One arm directed and held upwards and the other arm outwards is frequently useful in helping to partially restore the symmetry of the trunks (see photographs 7 and 8, which represent a girl, aged seven years, with severe lateral curvature, in the "habitual" posture [photograph 7] and the "best possible" posture [photograph 8]).

Sometimes the best result is obtained by both arms being raised vertically by the side of the head, while avoiding undue elevation of the shoulder-blades. This best position of the patient's trunk and arms for improving the spine is the "key-note" of the exercises to be practised during treatment.

A Committee on Lateral Curvature of the Spine, appointed on March 11th, 1887, by the Clinical Society of London, and before whom I demonstrated the same patients both before and after treatment, reported that "*The amount of improvement which may be hoped for in any given case may not unsafely be gauged by the improvement which the patient can voluntarily effect (directed or helped by the surgeon) in his or her position when first seen.*" *

* See Clin. Soc. Trans., vol. xxi., 1888, p. 301.

The importance of placing the patient in the "best possible position" at the first consultation is therefore evident. The patient is only able to maintain this position by a great effort for a few seconds, and she will feel as if she were more crooked than before. The muscular sense has become so perverted that the habitual position appears to her to be far more natural and straighter than the really erect or improved posture.

It is advisable before concluding the examination to let the patient stand erect, with her back against the door, heels, sacrum, dorsum, and back of head touching it, and with the shoulders well thrown back. While in this position, her mother or friend should try to fasten her stays and clothes in front. In most cases these will not meet for one or more inches, such great alteration and enlargement of the thorax anteriorly being temporarily effected by this simple device. This applies not only to female, but also to male patients, the waistcoat, coat, and overcoat, and frequently even the shirt-collar, not meeting for an inch or more when the patient is placed thus with his back against the door. Finally, the stockings being removed, notice should be taken whether the patient is flat-footed or not. One out of every three cases of lateral curvature of the spine has marked flat-foot (see Appendix).

Treatment.—Common-sense suggests that any inequality in the potential or practical lengths of the lower extremities is to be corrected by wearing

a thicker sole on the shorter leg, whatever other treatment may appear to be indicated.

Of late years the implicit faith formerly placed in the treatment of lateral curvature of the spine by steel and other spinal supports or stays has been gradually undermined, and even those who still adhere to the mechanical treatment of spinal deformities not due to diseased bone attach more and more importance to its association with suitably prescribed gymnastics. Lateral and other curvatures due to paralysis of the spinal muscles, when the patient is unable by a voluntary effort to maintain himself in an improved position for even a few seconds, are the only cases in which spinal supports may be of some use. In these paralysed backs, attempts should be made to prevent further increase of the osseous deformity; and in some cases this is possible by the application of a well-made Bauer posterior spinal support, which is fixed by means of a strong leather pelvic band and shoulder straps. This support may be worn till the muscles have sufficiently recovered from their paralysis to enable the patient to hold the spine in an improved position even for a few seconds. It is understood that this support is worn with the sole idea of being preventative, and not of being curative, and should be left off at night in bed.

Lying on the back for several hours daily, still almost universally prescribed by orthopædic and other surgeons, is perfectly useless as far as cure of the lateral curvature is concerned. If a limb

with weak and flabby muscles were put into stiff splints and kept at rest for several hours daily, the muscles would surely become still weaker; and this is equally true of the spinal muscles. The patient may lie on the back or face for fifteen or thirty minutes at a time for the relief of pain or when fatigued by exercise; but lying for longer periods does far more harm than good.

The treatment I advocate is based upon principles which may be taken under the following heads:—

(*a*) Re-education of the patient's muscular sense as to an erect or improved position.

(*b*) Improved position to be maintained at all times, while sitting or standing.

(*c*) Attention to dress.

(*d*) Systematic training of the spinal and other muscles, including the development of the thorax.

(*e*) Attention to general health.

(*f*) Subsequent home treatment to prevent relapse in the improvement or cure that has been obtained by the surgeon.

(*a*) *Re-education of the patient's muscular sense as to an erect or improved position.*—A patient with confirmed lateral spinal curvature is so habituated to the crooked position that considerable patience and perseverance is required to convince him or her that an erect or improved posture is really such, and not an exaggeration of the deformity. The best way of commencing this re-education is for the patient to lie on the back in the best possible position, and while thus to

practise slow breathing, the shoulders being kept well pressed back. All the simple movements of the head (neck), arms, and legs can be practised in this position. A hand looking-glass as well as an ordinary wall mirror are very useful, so that the patient may see and be convinced of the improved position. This re-education of the muscular sense for the improved or normal posture is to be kept in mind throughout the whole treatment.

(*b*) *Improved position to be maintained at all times, while sitting or standing.*—This best possible posture is always to be maintained while sitting, whatever the occupation of the moment may be: at meals, at the piano, while reading, writing, etc. It is most readily obtained by sitting with the sacrum, loins, dorsum, and shoulders well supported against the back of the chair, which should be moulded to the normal shape of the spine, with a slight prominence to fill the hollow of the loins. Almost any ordinary chair can be made to answer the purpose, if a suitable cushion is used. In writing, the patient's trunk is required to be more vertical than for reading; and it is essential that not only the trunk, but the arms, should remain perfectly symmetrical. A sloping desk is absolutely required; and the paper should be placed obliquely upwards from left to right, but exactly in front of the patient. The Glendenning adjustable modern school desk and seat, manufactured by the North of England School Furnishing Co., Darlington, will be found most beneficial for patients of school age, and even for many adults

(see figs. 2, 4, 5, 6). In reading, an inclined back to the chair is more restful to weaker patients,

Fig. 5.

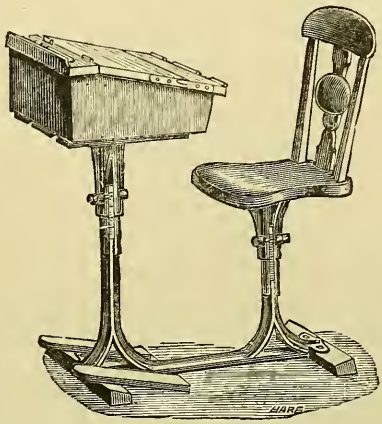
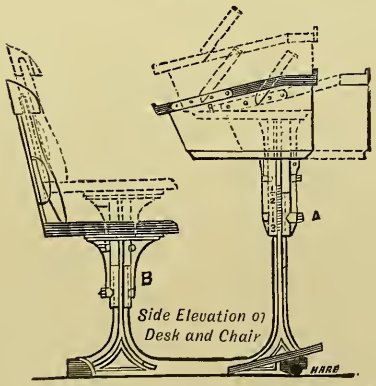


Fig. 6.



Explanation.—By the application of a key to A and B, the desk and seat may be raised or lowered to any desired height.

Desk top slides horizontally.

Writing slope at 15°, reading at 40°.

especially adults; and an easel table should support the book (see fig. 7). For music the same rules

apply, the ordinary music-stool being discarded and a high-backed chair employed, which will

Fig. 7.

Fig. 8

Fig. 9.

PRACTISING.

Position on ordinary music-stool.

Position on Glendenning's Patent Music Chair.

also come in useful for meals (see fig. 9, which represents a good music-stool with back, also

manufactured by the North of England School Furnishing Co., Limited). In all cases, the seat of the chair or couch should be horizontal, and not tilted up in front, as is frequently seen in so-called spinal couches; and the patient's feet should always be supported, either by the ground or by a foot-stool. The thighs should never be crossed, as this throws the spine as much on one side as does standing on one leg.

When we find an able surgeon not only advocating shoulder-braces, but even inventing a new one, still more injurious than most of its predecessors, because of its greater strength from being manufactured of solid rubber bandage,* one feels inclined to rub one's eyes and to ask whether scientific orthopædic surgery is really advancing or whether we have gone back half a century or more.

John Shaw, that enlightened and able author of a more rational treatment of lateral curvature, criticised shoulder-straps as follows: † "The effect which this instrument (shoulder-brace or 'common back-collar') produces in ordinary cases may be easily comprehended. . . . If the shoulder-blades be brought close to the spine by the straps of the brace and kept constantly so, there can be no use for the several strong muscles which pass from the spine to the shoulder-blades. They must conse-

* See the *Lancet*, May 3rd, 1884: "On a New Form of Shoulder-brace for the Treatment of Stooping Habits, Incipient Lateral Curvature, etc"

† "Further Observations on the Lateral or Serpentine Curvature of the Spine. . . . Being a Supplement to the Work on Distortions of the Spine and Bones of the Chest." London: 1825.

quently waste and become nearly useless, while those on the forepart of the chest, being excited to resist the straps, will become increased in power; and hence, when the brace is taken off, not only will the shoulders fall forward, as in a delicate person, but the muscles on the forepart of the chest will predominate over those by which the shoulder-blades should be held back and *pull* the shoulders forward."

This was written upward of sixty years ago, and is so complete and simple a refutation of any supposed efficacy of shoulder-straps for stooping habits that I have little to add to John Shaw's scientific common-sense.

I have observed in numerous instances where shoulder-braces have been worn for several months or longer, and where, from misplaced perseverance and severity, they have been worn extra tightly, that the unfortunate wearer has tried to obtain relief from the excessive pressure of the straps over the coracoid process and adjacent clavicle on each side, by throwing the whole upper trunk backward by undue arching of the loins, with the result of producing severe lumbar lordosis in addition to the dorsal kyphosis for which the apparatus was being worn. I am quite aware that dorsal kyphosis is generally accompanied by compensatory lumbar lordosis, but in these cases to which I refer the lumbar hollow is much severer than usual and causes an exaggerated thrusting forward and prominence of the abdomen. Of course I am referring to the kyphosis of muscular debility, and not to that

due to spinal caries. In spite of these facts, many medical men of the present day are in the habit not only of allowing, but even of advising, patients to wear these instruments of torture.

The only way in which shoulder-straps might be worn with benefit—not that I ever recommend them—is well illustrated by the following anecdote, which is also culled from good old John Shaw: An eminent surgeon was consulted by a gentleman who became one of our first tragedians as to the best mode of correcting a stoop which he had acquired. The surgeon told him that neither stays nor straps would do him any essential good, and that the only method of succeeding was to recollect to keep his shoulders braced back by a voluntary effort. But the tragedian replied that this he could not do, as his mind was otherwise occupied. The surgeon then told him that he could give him no further assistance. Shortly after this conversation the actor ordered his tailor to make a coat of the finest kerseymere, so as to fit him very tightly when his shoulders were thrown back. Whenever his shoulders fell forward, he was reminded by a pinch under the arms that his coat cost him six guineas, and that it was made of very fragile materials; being thus forced, for the sake of his fine coat, to keep his shoulders back, he soon cured himself of the stoop. He then showed himself again to the surgeon, who ever afterward, when consulted whether young ladies should wear shoulder-straps, permitted them on condition that they were made of fine muslin or

valuable silk, for tearing which there should be a forfeit!

I am totally opposed therefore to all mechanical contrivances for trying to fix the patient in an improved posture while writing, reading, etc., whether by means of braces, stays, or head—or rather forehead—rests, which last have been strongly advocated by several Continental surgeons. My results, which are far more rapid and so much more successful than those obtained by other methods of treatment, are won by the re-education of the patient's muscular sense for the improved or normal posture without the employment of any mechanical restraint.

Short sight or any other deficiency of the eyes must be at once attended to, by suitable spectacles, etc., as it would be useless to urge a patient to hold herself erect who had always to poke the head forward for reading or looking at anything.

Standing still should be avoided at all times; when inevitable, the patient ought to stand equally on both legs with the feet a few inches apart. Standing on one leg is most injurious, as it at once throws the spine into a serpentine position, increasing the lateral curvature.

A horsehair mattress with a low pillow is all that need be advised for the night.

(*c*) *Attention to dress.*—It is essential that no article of clothing should interfere with the resumption of an improved or perfectly normal position of the patient's spine and trunk. This can be tested by making the patient stand with

the back to the wall and with the clothes opened in front, as already mentioned (see p. 13). In girls up to puberty, and even later, three articles of dress are generally sufficient, viz., a pure wool combination next the skin, thick for winter, thin for summer, a petticoat or divided skirt with bodice attached, all of wool, and an outer dress. An extra petticoat may be worn in very cold weather. In women there should be no red zone of pressure on the skin of the thorax or abdomen produced by stays or injudiciously placed tight petticoat bands; the latter should be shaped and made to fit round the pelvis, so as not to compress the lower ribs above the hip bones (iliac crests). Stays with very little whalebone or steel, and with a vertical slip of elastic webbing, expanding transversely, inserted on each side, are advised whenever the breasts are at all developed. Such stays admit of the full expansion of the lower ribs, and are worn, not with the object of supporting the spine, but for steadying the mammæ and keeping the outer dress neat and without folds.

(*d*) *Systematic training of the spinal and other muscles, including the development of the thorax.*—At first, attention is to be directed to correcting the antero-posterior curves of the spine; when these are improved, then only is it possible to carry out special exercises for correcting the lateral curves.

The following is a prescription of twelve exercises with which I always commence the treatment of cases of lateral curvature of the spine. The

patient should rest for a minute or two between each exercise on a couch with movable back fixed at an angle of 45° (see fig. 7), or an ordinary chair properly arranged :—

1. Lying on back; arms by the sides of the body; palms upwards; slow, deep inspiration by the nose; slow expiration by the mouth. (Repeated four times.)

2. Similar exercise with the arms extended upwards by the sides of the head. (Repeated four times.

3. Same position as (1); head-rotation on axis to right and left alternately; also lateral flexion of head to right and left alternately. (Repeated four times.)

4. Lying on back; simultaneous circumduction of both shoulder-joints from before backwards; elbows and wrists kept extended. (Repeated twelve times.)

5. Lying on back; one hip circumduction both ways; knee kept extended. (Repeated ten times.)

6. Lying on back; simultaneous extension of arms upwards, outwards, and downwards, from a position with the elbows flexed and close to the trunk. (Repeated four times.)

7. Lying forwards; one hip circumduction both ways; knee kept extended. (Repeated ten times.)

8. Sitting on couch, with back at an angle of 45°; ankle circumduction down, in, up, and out, while the toes are directed inwards the whole

time. (Repeated twenty times.) Also foot adduction, patient resisting; abduction, surgeon resisting. (Repeated eight times.) (For flat-foot.)

9. Lying on back, with arms extended upwards by the sides of the head; flexion of both arms, surgeon resisting by grasping the hands, followed by extension, patient resisting. (Repeated six to eight times.) (The patient's knees, flexed over the end of the table, fix his trunk.)

10. Patient astride a narrow table or chair without back, with arms down and hands supinated; trunk flexion at lumbar vertebræ, patient resisting slightly, followed by trunk extension, surgeon resisting by his hand against back of patient's head. (Repeated six to eight times.)

11. Patient, with arms extended upwards, stands with head, back, and heels against a vertical post with pegs on each side, which he grasps. The surgeon gently pulls the patient's pelvis forwards by his hands on the sacrum, patient resisting; and then the patient moves back the pelvis to the post, surgeon resisting. At no time are the patient's heels to be raised from the floor. Also pelvis rotation on its axis to right and left alternately, surgeon resisting with his hands on each side of the pelvis. (Repeated six to eight times.)

12. Lying on back, with head and neck projecting beyond the end of the table; arms by the side of the body, palms up; the head is gently flexed by the surgeon's hand on the occiput, patient resisting, followed by head extension, surgeon resisting. (Repeated eight times.)

The last four exercises are personally carried out by the surgeon, while trained female assistants do the remaining eight under his supervision.

It is important, while practising this prescription of exercises, that respiration should not be interfered with by involuntary fixation of the chest walls. The patient should therefore always count aloud (*e.g.*, 1 to 5 or 10) during the execution of all exercises, except those of breathing. Six to twelve firm longitudinal "strokings," from above down, of the patient's back by the assistant's palms, generally remove any aching caused by the exercises. These strokings are also usefully employed at home to relieve backache. The exercises should be done slowly, and great care taken that the head and trunk remain the whole time in the best position. This prescription requires three-quarters to one hour's time to go through, and should be followed, if the patient is at all tired, by a short rest in a good position, with the back supported.

The prescription is repeated daily; and as the patient gradually gains more power and begins to assume the improved position more readily and with less exertion, other and more severe exercises are gradually added. In a day or two, if the patient is not overfatigued, the following *standing* exercise is done: The patient, with the feet slightly apart and the heels fixed against a ledge or wall, rests with the front of the thighs against a low padded horizontal bar, while holding herself as erect as possible; the surgeon then gently flexes the patient's trunk by pressing his hand

against the back of her head, patient resisting; and then the patient slowly recovers the vertical position against the surgeon's resistance, this being, in fact, exercise (10) described above, in a standing instead of a sitting posture. In about three weeks or a month, the following much more severe exercise can be tried, known as "*Forwards lying, heels fixed, trunk extension and flexion,*" carried out as follows: The patient lies prone, with the pelvis and legs supported and the heels fixed (the latter best by some one sitting on them) on a padded table, while the head and trunk to the level of the iliac crests project beyond the edge of the table. The patient slowly raises the trunk into the same horizontal position as the legs and pelvis, and slightly higher, and then as slowly allows the trunk to be again flexed by its own weight. The surgeon easily increases the severity of the exercise, if required, by more or less pressure with one hand at the back of the patient's head. During this exercise, the arms may be in any position required. By the time the patient is able to perform this exercise without pain, the antero-posterior curves will be sufficiently improved; and more attention can be paid to her being exercised in the "key-note" position—*i.e.*, that position of the trunk and arms in which the greatest improvement in the position of the spine is obtained (see p. 12). Another severe exercise which can also be practised now is shortly described as "*Long sitting, trunk extension and flexion.*" Here the patient sits on a table, with the legs together and

the knees extended; an assistant sits on the legs below the knees, to fix them; the patient slowly extends the spine against the surgeon's resistance (applied by his hand against the back of the patient's head or back) till the trunk is in the same horizontal plane as the legs; the patient then slowly and gently resists, while the surgeon raises her into a vertical position of the trunk.

Female patients usually continue the daily repetition of these exercises during the menses, except that the hip circumductions are omitted for three or four days, as these movements tend to increase the menstrual flow. Where menorrhagia or dysmenorrhœa is present, it is sometimes necessary to leave off the exercises altogether for a day or two. As a general rule, it is better to accustom the patient to practise most of the exercises all through the period of menstruation. While on the subject it may be stated that flexions of the uterus are no hindrance to the treatment, as none of the exercises described are violent or jerky in their execution; and, from the fact that respiration is never allowed to be impeded by the previously mentioned simple device of making the patient constantly count aloud, any over-exertion can always be prevented with ordinary care. I have several times given a three months' course of treatment with the usual beneficial result even while a pessary has been worn, and this with the permission of the gynecologist. The patient's spine should be examined again at the end of

three or four weeks, to observe how it is affected by the treatment and whether any alteration of details is required.

In cases of "non-osseous," or "postural," lateral curvature, one or two months' daily perseverance in the treatment will effect a cure of the deformity; while in cases with "osseous" deformity three months' daily treatment will, on an average, effect all the improvement that is possible, viz., a strong and straighter back, with arrest in the further increase of the deformity of the ribs and vertebræ. Some very severe cases, especially those associated with much pain, require as long a treatment as six months; but this is exceptional. The great advantage of this treatment of lateral curvature over that by spinal supports and lying down for many hours daily is that it always tends to improve the general health of the patient, notably in delicate, anæmic, and badly nourished girls at the onset of puberty.

(*e*) *Attention to general health.*—Care should be taken to improve the general health in every possible way. If the appetite is poor, a good basin of bread-and-milk or oatmeal porridge and milk should be ordered for breakfast, and patients made to persevere, even if they complain of discomfort at first. This especially applies to young ladies who have been in the habit of taking only half a slice of dry toast and a cup of tea or something similar for breakfast. In emaciated patients the true weight should be obtained by deducting the weight of the clothes after weighing; an increase

of from one half to two or three pounds is generally obtained after one month's treatment.

Patients with constant wearying *backache*, generally in the loin muscles, especially at night, are much relieved by a simple water compress, applied as follows: A soft towel or handkerchief, folded into an oblong about eight inches by six, is dipped into warm water, squeezed moderately dry, and placed over the painful spot. This is kept in position by a thicker dry towel folded longitudinally, which should be sufficiently wide to overlap the wet compress by at least an inch above and below, and fastened in front of the thorax by tapes or safety pins; no oil-silk should be used. Some patients prefer the compress applied cold; but this matters little, as it soon assumes the temperature of the body. When the pain is distinctly localised, as below one scapula or over one or several vertebral spinous processes, I have found the employment of an acupuncture instrument, such as Dr. Brindley James's, frequently useful in effecting an immediate and sometimes a permanent cure of the neuralgia. A daily morning bath with cold or tepid water, if the patient's powers of reaction are low, is a good general tonic. Singing, by helping to develop the thorax, is useful. At least one and a half to two hours' daily walking out of doors is to be insisted on; running and joining in games, especially lawn tennis, are beneficial after a time, provided any fatigue thus induced disappears after resting for a quarter or half an hour; any walk or exercise

that induces fatigue or pain lasting hours only does harm. In such cases, the duration of the walk, etc., must be curtailed.

(*f*) *Subsequent home treatment to prevent relapse in the improvement or cure that has been obtained by the surgeon.*—To keep up the improvement and to prevent any relapse in a cured case, it is important to continue to enlist the patient's co-operation and interest in his or her own case on ceasing treatment; and for the last ten years I have been in the habit of giving patients on leaving a written *home prescription* of movements, of which the following is an average example.

Final home prescription of exercises:—

1. Lying on back; arms by sides; palms upwards; slow, full inspiration by the nose; slow expiration by the mouth (four times).

2. Sitting astride a chair, with the arms directed upwards by the sides of the head and holding a stick (or as in 1); trunk lumbar flexion and extension; also trunk rotation on its axis right and left (six times).

3. Same position as (1); head-rotation on axis to right and left; also head lateral flexion to right and left (four times).

4. Lying prone on ground; heels fixed by pressure on them; arms as in (2); trunk-raising (extension) and flexion; also trunk rotation on its axis right and left (six times).

5. Same position as (1); one hip circumduction both ways; knee kept extended (ten times) (a shot

weight of five to ten pounds is attached to the foot to increase the severity of the exercise).

6. Lying on back; slow simultaneous circumduction of both shoulder-joints from before backwards; elbows and wrists extended (twelve times).

7. Lying prone on ground; heels fixed by pressure; trunk kept raised from ground (extended); simultaneous extension of the arms upwards, outwards, and downwards from a position of elbows flexed and close to the trunk (four times).

8. Standing with back against door, arms directed upwards, and hands grasping two pegs fixed into the door; pelvis rotation on vertical axis right and left (ten times); also the same hanging with the feet raised off the ground and sacrum kept touching the door (four times).

9. Lying prone; one hip circumduction both ways; knee kept extended (a bag of shot, weight of five to ten pounds, is attached to the foot to increase the severity of the exercise).

10. Walking forwards and backwards with the arms directed upwards by the sides of the head and holding a stick, or arms by sides; palms directed forwards (a hundred steps).

This "home prescription" is practised for half an hour twice a day for six months, and then once a day for another six months. At the end of the twelve months I examine the patient; and if the improvement or cure previously effected shows no relapse, I give permission to leave off all special treatment. In all cases it is absolutely necessary

to persevere in the maintenance of good positions for some years.

During the treatment horse exercise is not advised, at least not for the first year; afterwards it is permitted, but female patients should use a reversible saddle, and learn to ride alternately on the "near" and "off" side.

The following three cases are illustrative of the treatment described above. Case I. was exhibited before the Clinical Society of London on April 13th, 1883 (see Clin. Soc. Trans., vol. xvi., 1883):—

Case I.—Miss ——, æt. eighteen, a student at one of the London academies of music, was brought to me on March 4th, 1882, with the following history: Three paternal aunts had spinal curvature, one much deformed; the patient is one of sixteen children, of whom ten are living. Two younger sisters, aged sixteen and fourteen years respectively, stoop considerably, but have no lateral curvature. Up to fourteen years old (four years ago) the patient was strong, and never complained of her back. She then began to stoop and have backache, especially after long walks; the pain in the back would last till she went to bed. There was no illness or rapid growth to account for this weakness of the spine. The backache gradually became worse; and three years ago the patient was examined by one of the surgeons of the Sussex County Hospital, who said the spine was not straight; and she was ordered to lie down for two hours daily and to eat slowly. At the end of another year, the same surgeon

found the spine decidedly worse, so an ordinary steel spinal support, with pelvic band and shoulder crutches, was ordered of Pratt. This instrument has been worn for two years up to a month ago, the mother assuring me that her daughter had become worse both in her figure and the backache during that time.

On examination, I found the patient rather thin and the subject of lateral curvature, the whole spine being convex laterally to the left, the right scapula being more than two inches below the level of the left one; also considerable exaggeration of the cervico-dorsal antero-posterior convexity, causing poking of the head, much flatness of the thorax anteriorly, and even undue prominence of the abdomen, although she was so thin. I found a slight amount of permanent rotation to the left of the lumbar vertebræ, and a slight increase of the convexity of the left ribs posteriorly as compared with the right side when the patient's spine was flexed. Although the patient looked so deformed, she could be placed in an almost normal position, and maintain that position by a great voluntary effort for a few seconds. Her feet and knees were normal. Sitting for half an hour any time of the day would bring on severe backache. I was interested to hear that whenever she wished to sing extra well she left off the spinal support for the occasion. Her dress and stays were much too tight round the thorax, so that scarcely any inspiratory movement took place in the lower half of the thorax.

I gave her directions about position and a few simple exercises for developing the thorax, including systematic deep breathing, to be practised for fifteen to twenty minutes twice daily. I ordered the spinal support to be given up.

Nine months later—viz., on Dec. 18th—I saw the patient for the second time. Both she and her mother considered there was a decided improvement, notwithstanding severe backache for the last fortnight. The prescribed exercises have been on an average practised four times a week. Her professor of singing has complained of her want of "breath." On examining the spine, I found it in the same state as when I saw the patient the previous and first time.

Two days later—Dec. 20th—six photographs were taken, which speak for themselves (see photographs 1 to 6). Photographs 1, 2, 3, are the three views, posterior, lateral, and anterior, of the patient in her *habitual* position; and photographs 4, 5, 6, are the corresponding three views of the patient in the *best possible position* in which I could place her. In all six photographs she was standing without boots, with the feet close together and the knees fully extended, while the pelvis was placed symmetrically in relation to the feet. These photographs were taken by a quick process, yet it cost her considerable effort and backache to maintain the improved position in which I placed her for the few seconds necessary.

My prognosis was that the patient could be so strengthened by three months' daily treatment,

that this temporary improved position, involving such great effort when the photographs were taken, would become a permanent one without any effort, at the same time that all pain would disappear—that is, practically a complete cure, although a slight permanent rotation of the lumbar vertebræ would be left.

On Dec. 23rd the patient began daily treatment, visiting my house for three-quarters to one hour daily. The following are extracts from my notebook: —

"*Jan.* 15*th*, 1883, seventeenth visit for treatment. —For the last week the patient has been doing two or three exercises while the right arm is directed vertically upwards and the left outwards from the side of the trunk. Yesterday and the day before she was without backache the whole day. This is the first time for more than two years that there has been a day altogether without backache. The patient's professor of singing saw her to-day, and, without anything being said to him, at once observed the marked improvement in her figure, and on trying her voice, found there was an increased power of 'breathing.'

"*Jan.* 16*th*.—The patient tells me the dressmaker has had to let out her dress more than five inches across the chest. On examining the back, I found the habitual position decidedly less deformed than it was on Dec. 20th, less than a month ago. Her mother and friends noticed a decided improvement in her figure at home. Her appetite is much better, especially at breakfast.

"*Jan.* 31*st.*—The patient has had no backache since Saturday, viz., three clear days.

"*Feb.* 23*rd.*—The patient has not had any backache since Wednesday week, viz., ten days; previously she had rather severe backache for two or three days; during these last ten days she has been up to London and back four or five times, attending the Academy of Music.

"*April* 9*th.*—On examination I found the habitual position very much improved, scarcely any difference in the level of the shoulder-blades, and the antero-posterior spinal curves almost normal. The patient assumes the best possible position with great ease; the erectores spinæ muscles are now highly developed. When the spine is flexed, the left erector spinæ muscle is still too prominent. The whole trunk is vastly more symmetrical in the habitual position—that is, the one assumed without extra muscular effort.

"*April* 11*th* (Wednesday).—The patient is still without backache. If this lasts till to-morrow (Saturday), that will be four clear weeks passed without aching in the back.

"The patient is so much improved in figure and strength, that she is to cease treatment shortly."

["The young lady, the subject of the lateral curvature, was exhibited, and went through the various phases of the 'medical gymnastics' which had been practised with the view of bringing about a cure. The muscles, when in action in the different movements, came out very strongly. The

case seemed to have undergone marked improvement."—*Medical Times and Gazette*, April 21st, 1883.]

This young lady two years afterwards went on the stage of one of the leading theatres in London, and has continued to act up to the present time.

When the Clinical Society's Committee on Lateral Curvature of the Spine was appointed on March 11th, 1887, nearly the first letter I received from the Hon. Secretary was one requesting me to exhibit this patient before the Committee. The young lady most kindly consented, and she was thoroughly examined by all the members of the Committee on April 15th, 1887. She also informed the Committee that the dressmaker of the theatre had never found fault with her figure when trying on new dresses. I believe I am correct in stating that the Committee were satisfied that there had been no relapse since the patient had been exhibited at the Clinical Society's meeting four years previously. This was a severe test of the permanence of the cure I had been able to effect, because this young lady at the time she saw the Committee at my house was not only acting every night in two pieces, but was rehearsing for several hours daily in a new play, which was soon afterwards successfully placed on the stage.

Case II.—Miss E. L., æt. seventeen years, from Jersey, consulted me on April 24th, 1888, with the following history: About eight years ago "the right shoulder was observed to be growing out," the only ascertainable cause being a very rapid growth. The

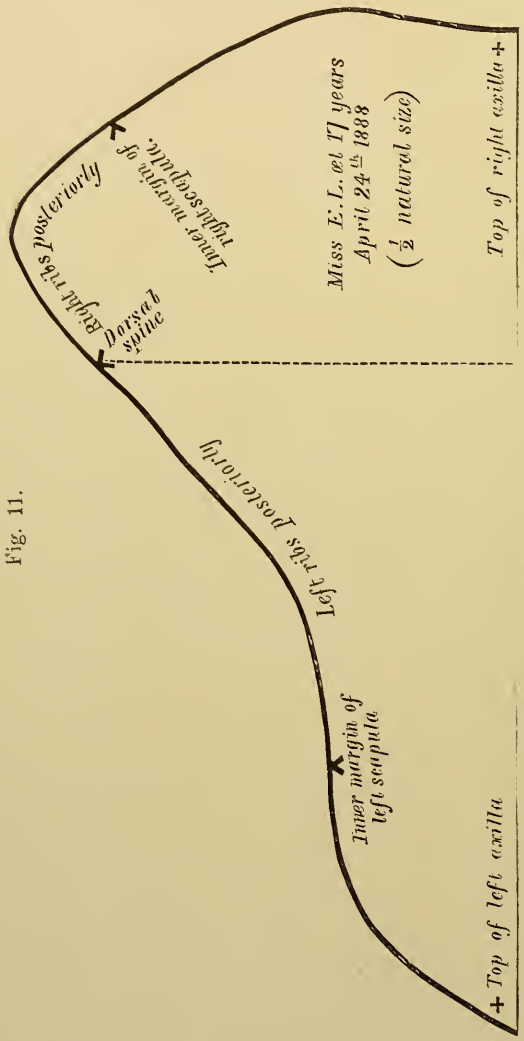
family doctor on being consulted advised nothing being done, as "it would all pass away." Four years ago, the patient in the meanwhile having become more deformed, a steel spinal support was applied and worn for six months; this was then replaced by a series of four Sayre's plaster-of-Paris jackets, applied at intervals of three months; then

Fig. 10.

Rough sketch of back of Case II., with extreme lateral curvature (habitual posture).

a poroplastic spinal support was applied, and had been worn for two years up to the time of consulting me. In spite of the continuous mechanical treatment of the last four years, the young lady had become terribly deformed, as can be easily seen from the rough sketch of the back (fig. 10), and from the reduced copies of the tracings of the ribs posteriorly (fig. 11) and of the loins (fig. 12), which

I took according to the method already described.



Tracing of ribs posteriorly, taken from one axilla to the other, in flexed position of trunk, in same patient as Fig. 10 (half natural size).

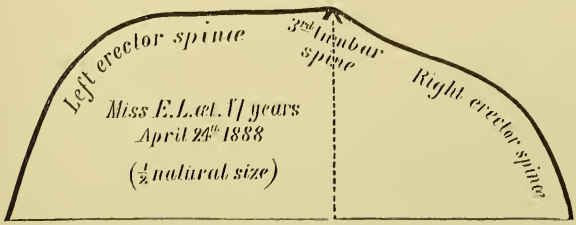
These show the extreme deformity of the right ribs behind, and the serious prominence of the left

hip-bone. The ribs anteriorly are likewise much deformed, and the whole thorax is consequently most unsymmetrical.

When the patient was placed in the best possible posture, with the back against the door, her stays, dress, and jacket would not meet in front for three or four inches. Her general health at the time of the consultation was only "pretty" good, and the patient complained of frequent pain in the back and beneath the left shoulder-blade.

I gave as my prognosis that three months' daily

Fig. 12.



Tracing of loins midway from ribs to iliac crests in flexed position of trunk, in same patient as Figs. 10 and 11 (half natural size).

treatment would effect all that could be done in such a bad case, viz., a slight improvement in the spine, a better figure, a much stronger back, and a marked improvement in the general health, and at the same time an arrest of further increase in the osseous deformity of the ribs and vertebræ. The patient came under my care a day or two afterwards, the spinal support being of course left off altogether; and the following notes of the progress of the patient are taken from my case-book:—

"*May 15th.* Eighteenth visit for treatment.—The

patient began to-day the severest exercises; she is doing extremely well.

"*May* 30*th*. Twenty-ninth visit for treatment; examined; 'key-note' is a position of 'left arm directed upwards, right arm directed outwards.' There is slightly more movement in the spine,

Fig. 13.

Rough sketch of back of Case III., with severe lateral curvature (habitual posture).

which is also a little less curved; the patient is already much stronger.

"*July* 21*st*. Seventy-first visit for treatment; examined. The spine is still further improved both in straightness and increased movability; still the same 'key-note.'

"*July* 23*rd*. Seventy-second and last visit for

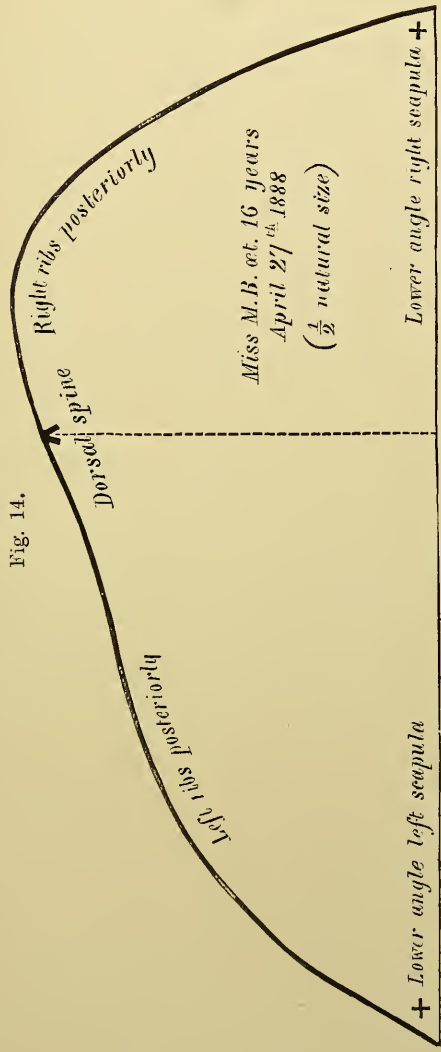


Fig. 14.

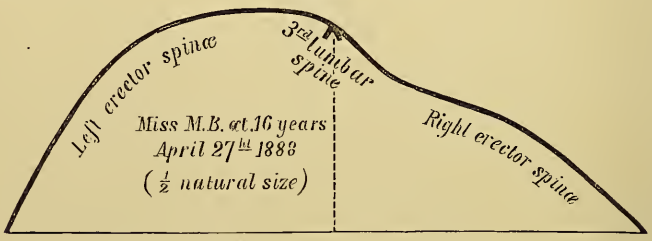
Tracing of ribs posteriorly taken from lower angle of one scapula to that of the other, in flexed position of trunk, in the same patient as Fig. 13 (half natural size).

treatment.—A home prescription very similar to that described on p. 31 was given to the patient

to be practised daily at home for the next twelve months."

On December 9th, 1888, more than four months after leaving England, the patient wrote to me as follows:—"I am pleased to say that I keep up very well. I do my exercises either in getting up or during the morning and before going to bed. . . . All my dresses were much too narrow across the chest, and too short in the waist. . . . My general health has much improved, and also one thing I am most thankful for is that those pains I used to have in the left side have entirely disappeared."

Fig. 15.



Tracing of loins midway from ribs to iliac crests, in flexed position of trunk, in same patient as Figs. 13 and 14 (half natural size).

Case III.—Miss M. B., æt. sixteen years, the fifth of eight children, all delicate, was sent to me on April 27th, 1888, by the advice of Mr. C. Heath. Her previous history was that three years ago the right shoulder was observed to be "growing out;" she was at once taken to a surgical instrument maker, who applied a steel spinal support, which was worn for two years. The deformity becoming much worse, the patient consulted a London orthopædic surgeon, who prescribed another steel spinal support, which was being worn when I was

consulted. The friends described the patient as becoming rapidly worse during these three years since they first observed the curvature. Figs. 13, 14, 15, sufficiently describe the case, exhibiting as they do the moderate deformity of the right ribs posteriorly and the severe deformity of the left loin, caused by the rotation backwards of the left transverse processes of the lumbar vertebræ, which form a severe lateral curve with convexity to the left. This young lady came for three months' daily treatment. On July 9th, 1888, the father wrote, "I beg to congratulate you on the great success in your treatment of my daughter;" and on January 12th, 1889, nearly six months after the patient left my personal treatment, he wrote, "I am pleased to tell you that my dear daughter is very much better for the three months' treatment under your care. She walks more uprightly, and does not become so easily fatigued as she did before she went under your care. Her deformity is scarcely noticeable now as she walks along, and she is in good health and spirits. . . . I was truly delighted for her to leave off that wretched instrument which had been made for her by the order of the surgeon she had previously been to, and which was not only a great disfigurement and a very heavy thing for her to be always carrying about her, but never did her the slightest good."

I would refer medical men who wish to know more about the results obtained by the treatment here advocated to a series of two hundred consecutive cases of lateral curvature of the spine

which I had treated without mechanical spinal supports up to April 4th, 1885, and on which I published a paper in the *British Medical Journal* of October 31st, 1885. In that paper, which I had previously read at the annual meeting of the British Medical Association at Cardiff in 1885, I gave not only a concise description and the results of the treatment of each case, but also the names of the medical men by whom a large proportion of the patients had been sent to me. It will suffice to give the following three extracts from that paper: "In the column headed 'Previous Treatment' it is interesting to note that many of the cases have been under instrumental treatment for years. Thus case 9 wore a steel support sixteen years; case 19, a steel support four years, during which period it was screwed up a hundred and ninety-five times by the surgeon; case 32 had a steel support seven years; case 73, a steel support eight years; case 125, a steel support eighteen years; case 155, a steel support six years and a poroplastic jacket for a year or two longer; and case 166, a steel support twelve years. From all these cases I removed the spinal support at once, and so strengthened the spinal muscles that the patients were able to hold themselves permanently in a much better position than when wearing the supports, in all cases with much benefit to the general health.

"In the last column but one the result of my treatment is given as 'improved,' 'much improved,' 'very much improved.' I have not ventured to

put down 'cured' in any case, although 'very much improved' is almost synonymous, because I have ever maintained that any case of lateral curvature of the spine with even a trace of osseous deformity, due to rotation of the lumbar, dorsal, or cervical vertebræ, is to that extent incurable; while, on the other hand, some surgeons deny that lateral curvature is present unless there is some permanent rotation of the vertebræ visible externally.

"Only three cases out of the two hundred are noted as 'not improved,' which was due to deficient energy on the part of the patients and neglect to carry out my directions."

I have therefore given the profession ample material for thoroughly testing the efficacy of the treatment I employ.

Summary of Prognosis and Treatment.

1. If osseous deformity be present, even to a slight extent, complete cure of lateral curvature is impossible.

2. Many cases of apparently severe lateral curvature of the spine have no osseous deformity, and can be at once restored temporarily to a good position.

The Clinical Society's Committee on Lateral Curvature of the Spine classify all lateral curvatures as (1) *cases without osseous deformity* and (2) *cases with osseous deformity*, according as there is or is not bony deformity present (see their report in vol. xxi. of Clin. Soc. Trans., 1888, p. 301).

3. A patient with confirmed lateral curvature, with or without osseous deformity, is so habituated to the vicious position, that attempts on his or her part to improve the spine, *except by the surgeon's directions*, generally increase the deformity.

4. Exercise of the spinal muscles, with or without resistance by the surgeon or a trained assistant, is absolutely necessary to the successful treatment of lateral curvature.

5. Good positions should be always assumed, not only at meals and at lessons, but whenever otherwise occupied. This is practicable in slight cases with ordinary chairs; in some cases a couch with horizontal seat and movable and moulded back is useful.

6. Special attention is to be directed to the dress (including stays, braces, etc.) in both sexes, so that it presents no obstacle to the expansion of the thorax anteriorly and to the patient maintaining an improved or an erect position.

7. The feet should always be examined in cases of lateral curvature, as "flat-foot" is so frequently concurrent with the spinal deformity, and requires to be attended to at the same time.

8. A moderate amount of walking and outdoor games and exercise, short of much fatigue, is beneficial.

9. Lying on the face or back does not tend to cure lateral curvature, as it does not strengthen the spinal muscles. Lying for fifteen or thirty minutes is useful when it rests the patient; but if it be continued for several hours daily, only harm

results from the physiological activity of the spinal muscles being prevented.

10. Sayre's plaster or poroplastic jackets and steel spinal supports are never to be employed except in cases of lateral curvature due to paralysis of the erectores spinæ muscles, where the patient is unable by an effort to maintain an improved position of the spine for even a few seconds, and then only with the object of preventing further increase, if possible, in the osseous deformity of the ribs and vertebræ.

11. The more attention is paid to the avoidance of vicious and to the maintenance of good positions, and the more carefully and conscientiously the patient carries out the prescribed exercises, the better and quicker are the results obtained.

12. Slight cases of lateral curvature of the spine without any osseous deformity can generally be cured in one month by one hour's daily treatment; other cases, on an average, require three months' treatment for an hour daily, to effect either a cure in those cases which can be cured (postural, or non-osseous stage), or the utmost improvement possible in others where there is more or less osseous deformity present (osseous stage).

The age of the patient has little or nothing to do with the success of the treatment I employ; all that is required is the willing and persevering co-operation of the patient. At the present time (January, 1889) my youngest patient is a little girl three and a half years old, sent me by a Brighton practitioner, who has improved greatly by the

course of treatment now almost completed; and last month (December, 1888) I said good-bye to a lady aged fifty-seven years, who had worn steel spinal supports for forty years, the last twenty years under the same London orthopædic surgeon, and whose pain and suffering were described to me by the son (a medical man) as "incredible in amount." This lady's spinal support I removed at once, and by the end of the three months' treatment she was able to undergo the severest exercises without any pain; and she has now left me with a strong and straighter spine, although a complete cure was out of the question, as there is very considerable osseous deformity of the ribs and vertebræ.

In all cases, constant attention to position and daily perseverance with prescribed exercises are required at home for at least a year afterwards to confirm the cure or improvement and to prevent relapse.

Lastly, the conscientious carrying out for about one hour daily of the treatment I advocate, and which I have briefly detailed above, will enable surgeons to cure or improve the vast majority of cases of lateral curvature of the spine on an average in three months from the commencement of the treatment.

APPENDIX.

THE TREATMENT OF FLAT-FOOT.*

Flat-foot is so frequently associated with lateral curvature of the spine that I believe the usefulness of this monograph will be increased by its treatment being also given.

Flat-foot may be defined as a falling down or giving way of the normal arch of the foot, which may be so slight as to escape notice, except from the discomfort it causes, or be so severe that the whole tarsus presents as great a convexity inward as it ought to present a concavity, with the foot so everted that the internal malleolus touches the ground, while the outer border of the foot is raised, with the sole directed outward, as in some cases of infantile paralysis.

Sir James Paget speaks of "the constant pain and weariness of the lower limbs associated with flat-foot. The feet are elongated, flat, low, without insteps; the heels are too little prominent, the plantar arches sunken, the ankles thick; the astralagus, navicular and inner cuneiform bones, are below their right level. The pains complained of are those of the muscles and tendons, which are habitually overworked in the task of keeping the body erect when its proper bearings on its supports are disturbed." I consider this description applies to a severe case not due to infantile paralysis. Pain and much deformity are not always associated together; growing boys and girls approaching puberty are frequently brought to me complaining of severe pain in the insteps whose feet exhibit scarcely any deformity. Again, the severest cases of deformity, those due to infantile paralysis, frequently have no pain or discomfort in the feet, although sensation is perfectly normal. Flat-foot is, therefore, a very general term, and requires some sort of clinical classification if surgeons are to come to any agreement on the proper treatment. I think the best classification is one I proposed some years ago, viz., (1) cases in which it is possible

* The greater part of this Appendix was read at the meeting of the New York Academy of Medicine, March 1st, 1888, and published in the *Medical Record*, New York, March 17th, 1888.

to restore the foot completely to the normal shape by passive manipulation, without any force exerted by the surgeon, or by making the patient stand with the heels raised; (2) cases where the tarsal bones have become more or less fixed in their displaced positions by shortened ligaments and tendons, osseous deformity of the articulating surfaces, and fibrous or osseous anchylosis, which require forcible manipulation under anæsthetics to restore more or less of a normal arch; (3) intermediate cases, in which a partial restoration of the tarsal arch is possible without *brisement forcé*.

A few words must be devoted to the causation of flat-foot, to enable us to obtain a correct view of the proper treatment. Mr. Le Gros Clark says, "In reviewing the action of the various muscles around the foot, it is obvious that their attachment is designed to preserve the plantar arch, and that such healthy condition must depend in great measure on the evenly balanced action of those muscles upon their several attachments. Thus the peronei and tibial muscles antagonize each other, and the expanded insertion of two of them into the tarsal bones is very instrumental in preserving the transverse as well as the antero-posterior arch."

I find that all infants on commencing to walk are normally flat-footed, without any tarsal arch, whereas after they have stood and run about a few months, and the leg-muscles have become developed, a perfect arch is formed. I have several times been consulted by an anxious mother about her baby's feet when the child begins to run alone, the normal absence of a tarsal arch being at first exaggerated by a pad of fat opposite the plantar aspect of the tarsus. I have always been able to reassure her, and to tell her that the feet would become arched in time and the adipose instep pad disappear; and the result has proved my prognosis to be correct.

Anything that tends to weaken the general muscular system during years of growth will also predispose to flat-foot. Thus I find that *out of every three cases of lateral curvature of the spine two suffer from flat-foot, and one severely so.* Flat-foot is also intimately associated with knock-knee; the one may follow close on the other, or both deformities may arise simultaneously.

Injury or chronic disease of one leg, throwing extra work on the sound limb, is also apt to produce flat-foot in the latter.

Although the bones of the tarsus are apparently so well supported by their ligaments and the tendinous prolongation of the muscles inserted in the sole, yet, as soon as these muscles shirk their work, from weakness or paralysis, undue strain is thrown upon the tarsal ligaments; and they gradually yield, accompanied by more or less aching and pain or none at all,

according to the idiosyncrasy of the sufferer. At first there is no osseous malformation, and so long as this is so, more or less complete restoration to the normal is possible; but in time the articulating surfaces become altered in shape, the bones distorted, and the ligaments so shortened and thickened that even with extreme *brisement forcé*, under anæsthetics, only a partial improvement is brought about. Indeed, the production of osseous deformity of the feet is caused in exactly the same way as is that of knock-knee. Flat-foot is therefore directly due to the weakness of the leg-muscles which are attached to the bones of the feet.

In the *treatment* of flat-foot we have to aim at the restoration and maintenance of the previously depressed plantar arch and the strengthening of the leg-muscles which tend to produce and preserve the normal arch of the foot. We have therefore to discuss (*a*) mechanical means for replacing and keeping up the plantar arch, and (*b*) therapeutic methods for strengthening the weak tibial muscles.

(*a*) *Mechanical means for replacing and keeping up the plantar arch.*—In groups (1) and (3) a boot or shoe should be worn broad enough across the metatarso-phalangeal articulations, best made from a tracing of the stockinged foot; and if the toes are much deformed or displaced, the stocking should be digitated and the toes well spread out on the ground. The heel of the boot should be low and broad, not more than double the thickness of the sole in front. For raising the depressed arch I employed for many years a pad made of superimposed layers of felt, and this, combined with treatment for improving the muscular power, has had good results; every now and then, however, a case proved very obstinate. For the last three years I have discarded pads altogether, and I no longer advise laced-up boots being worn; indeed, the more freedom left to the movements of the ankle the better, and I therefore recommend shoes to be worn. Instead of a pad which, if efficient, tends to bruise and irritate the already tender tarsus, I employ an increased thickening of the sole opposite the ball of the great toe and on the inner margin of the heel, according to the method of my friend Mr. H. O. Thomas, of Liverpool. His theory of the mechanical production of flat-foot appears to me to be the most rational; it is that in the normally constructed foot the lower end of the tibia is placed too much toward the inner border of the foot, so that the tendency of the tarsal arch is to give way under the pressure of the weight of the body, and has to be constantly combated by the efforts of the strong leg-muscles inserted into the foot. If we had to create a new foot and leg, simply with the view of preventing flat-foot, we should plant the lower end of the tibia rather more toward the

outer margin of the foot. The device of the wedge-shaped sole, with the base inside and the apex outside, tilts or rotates the foot on its longitudinal or antero-posterior axis and carries the lower end of the tibia toward the outer margin of the foot, and thus removes all or most of the pressure of the weight of the body as transmitted through the lower end of the tibia from over the tarsal arch, in the same way as in the imaginary newly created foot and leg. The increased thickness of sole is from one-fourth to one-half inch, according to the severity of the case; an addition of a corresponding one-fourth or one-half inch is added to the inner margin of the heel, and this thickness gradually diminishes to nothing at the outer margin, which should be protected by a thin plate of iron or steel studs to prevent further differences of level of the two halves of the heel from wear. The same remarks apply to the increased thickness of the sole, which gradually tapers to nothing at the tip of the sole, as well as at its outer margin. This wedge-sole can be applied to boots and shoes already worn. I believe that the benefit obtained by valgus pads under the depressed instep is really due to the patient being forced to walk on the outer border of the foot to avoid the discomfort and annoyance of the pad pressing against the tarsal arch. Boots made, and so much advertised, with movable or spring-like waists, are useless, and even injurious if the spring is prolonged to the outer margin of the sole, where the foot ought to rest entirely on the ground. As the chief movement in walking is at the metatarso-phalangeal articulations, it would be an advantage if this portion of the sole could be made of a more yielding leather.

In group (2), where the displaced arch cannot be replaced except by *brisement forcé*, I would recommend this being effected by Mr. H. O. Thomas' club-foot wrench, under anæsthetics, and the foot kept in a suitable splint in the improved position till all symptoms of the traumatism have disappeared, and the patient then treated as in groups (1) and (3).

(*b*) *Therapeutical methods for strengthening the weak tibial muscles.*—I know of no better exercise than walking on the toes with the heels raised an inch or so, taking care that they are not raised too much, for when the longitudinal or long axis of the foot behind the metatarso-phalangeal articulation is raised too vertically there is less work for the muscles, as much of the weight of the body is transmitted directly through the bones of the tarsus and metatarsus standing on end.

It is a good plan to order the patient to walk fifty steps on the toes before and after each meal.

The chief exercises I employ are the following: (1) "Standing, toes in, heels out, raising and lowering heels, repeated forty

times." The patient stands with or without shoes, with the toes touching and the heels separated, so that the feet are at right angles (*i.e.*, rotation inwards of the legs from the hips); he has then to slowly raise the heels and as slowly to lower them, while forcing the ankles outwards as much as possible the whole time. (2) "Sitting, foot inward circumduction, repeated forty times." The patient, sitting on the floor or couch, with the back supported and the knees extended, circumducts the foot down. in, up, and out, while the toes are directed inward the whole time; the knee and hip should be kept perfectly still. The leg should rest on a small pad just above the tendo Achillis, to leave the foot free. (3) "Sitting, foot adduction (surgeon resisting) and abduction (patient resisting), repeated twenty times." The patient is placed in the same position as before; the surgeon fixes the leg just above the ankle with one hand while the palm of the other exerts a gradually yielding resistance to the patient's effort to adduct and invert the foot. On the completion of the adduction the patient strives to maintain this position of the foot while gradually yielding to the pressure of the surgeon's hand gently pushing the foot back to the commencing position.

I sometimes employ another exercise, viz., walking on the outside edges of the feet with the soles directed inward and forward. Patients with flat feet will frequently assume this last position instinctively, to give relief to the overstrained ligaments of a displaced tarsus.

In cases of extreme weakness of the leg-muscles, rubbing (massage) of the leg-muscles for half an hour once or twice daily should be employed. For the technique, I can refer those interested to my article, "Massage," in Heath's "Dictionary of Practical Surgery."

Necessarily in cases of infantile paralysis, where the muscles have completely wasted, only the mechanical portion of the above treatment can be carried out, with the addition of an elevating steel spring to lift up the foot, for clearing the ground during walking, if there is foot-drop.

In all cases due attention should be paid to the general health, and to the removal of all debilitating causes.

Such severe treatment as the removal of a wedge-shaped piece of bone from the tarsal arch, under antiseptics, does not appear justifiable; and I have not yet seen a case which offered any reasonable probability of this treatment being of permanent benefit to the mutilated patient.

The effects of the treatment I advocate begin to be felt within a week or two by the patient; and I seldom see cases where all pain and discomfort has not disappeared within three or four weeks, some even within a few days. For the cure of the

deformity, even slight cases require several months; and for severe cases I generally find that a year or more of perseverance with the special soles and treatment is necessary.

I append a typical case, illustrating the treatment above described.

Mrs. ——, wife of an M.P., consulted me July 7th, 1884, with the following history: Two years ago she began to have discomfort in the feet after walking—"a feeling as if the ankles were too soft." The discomfort increased for six months, when she became a vegetarian; and for a time the pain in the feet was less. Since then the pain has become gradually worse up to the present. The patient is an active, extremely intellectual woman, fairly well nourished; she can only walk up and down stairs or a few yards out of doors, and that with considerable discomfort. I found both feet severely flat [intermediate, or group (3)], with the pain and aching just under the arch of the instep, and described as "a dull, aching soreness" which "becomes acute pain at times;" standing causes even more pain than walking. On August 25th—viz., *six weeks* later—patient wrote, "I am following your prescription as far as I can, and feel much better." Again, on November 18th, four months later, "I am a great deal better.. . . . When I was in London, I was trying to school my impatience to resignation to a walk of not more than a hundred yards at a time; now I can walk two miles without much fatigue, and am astonished at the elasticity and youthfulness of my movements. I consider myself a walking advertisement of your surgical capacity!" This lady has continued well up to the present time.

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